

### Bob O'Dette, M.S., P.E., BCEE

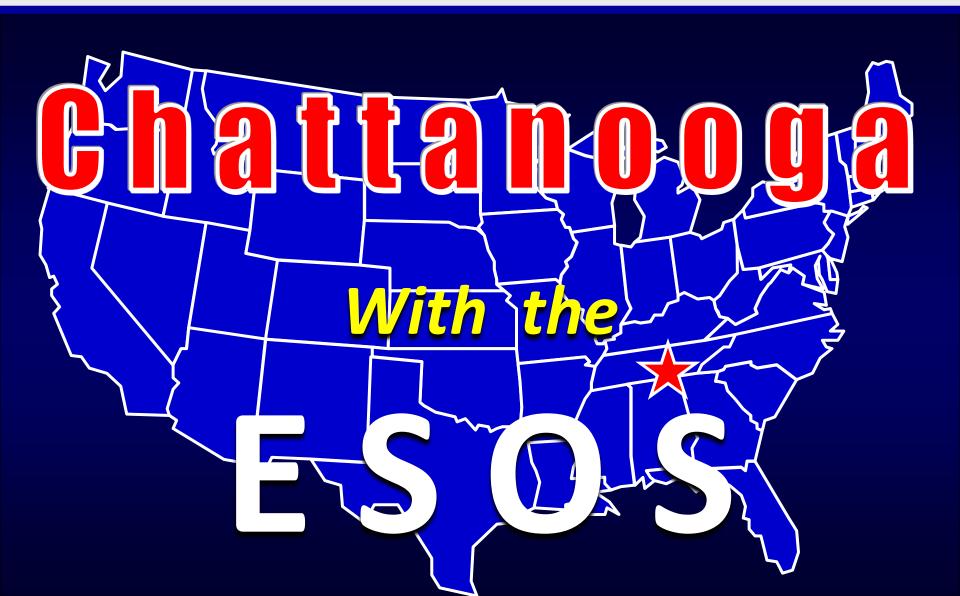
Division of Water Resources



Department of Environment & Conservation



## It's Great to be in





















# SEWER SYSTEM OVERFLOWS (SSO'S) AND/OR RELEASES

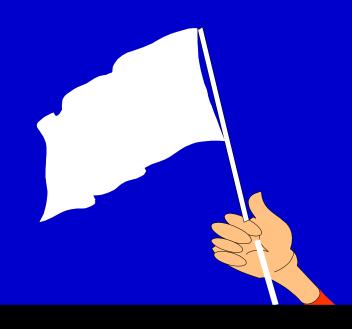




## We've got to come to a decision on I/I and Sewer Rehabilitation







In over your head with I/I problems?

# Collection Systems Metrics



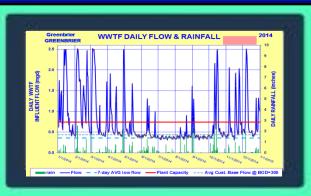
## Regulators

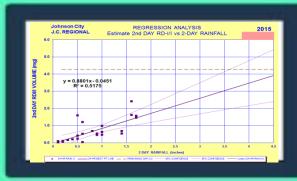


## Metrics















#### No. TN0021067

Authorization to discharge under the National Pollutant Discharge Elimination System (NPDES)

Issued By

## STATE OF TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION DIVISION OF WATER RESOURCES William R. Snodgrass - Tennessee Tower 312 Rosa L. Parks Avenue, 11<sup>th</sup> Floor Nashville, Tennessee 37243-1102

Under authority of the Tennessee Water Quality Control Act of 1977 (T.C.A. 69-3-101 et seq.) and the delegation of authority from the United States Environmental Protection Agency under the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 (33 U.S.C. 1251, et seq.)

Discharger: Millington Wastewater Treatment Plant

is authorized to discharge: treated municipal wastewater from Outfall 001

from a facility located: in Millington, Shelby County, Tennessee

to receiving waters named: Big Creek at mile 6.9

in accordance with effluent limitations, monitoring requirements and other conditions set forth herein.

This permit shall become effective on: July 1, 2017

This permit shall expire on: June 30, 2022

Issuance date: July 1, 2017

for Tisha Calabrese Benton

Director

## NPDES PERMIT

## **Municipal NPDES Permits**



#### 1.0. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

#### 1.1. NUMERIC AND NARRATIVE EFFLUENT LIMITATIONS

The City of Millington is authorized to discharge treated municipal wastewater from Outfall 001 to the Big Creek. Discharge 001 consists of municipal wastewater from a treatment facility with a design capacity of 5.8 MGD. Discharge 001 shall be limited and monitored by the permittee as specified below:

Description : External Outfall, Number : 001, Monitoring : All Weather, Season : All Year												
Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base					
80998	Bypass of Treatment	Report		occur/mo	Occurrences	Monthly	Monthly Total					
Description : External Outfall, Number : 001, Monitoring : Dry Weather, Season : All Year												
	Description	: External Ou	tfall, Numbe	r : 001, Moni	toring : Dry Weath	ner, Season : All Year						
Code	Description Parameter	: External Ou Qualifier	tfall, Numbe Value	r : 001, Monit Unit	toring : Dry Weath Sample Type	ner, Season : All Year Frequency	Statistical Base					

Code	Paramete	r (	Qualifier	Value	Unit	Sample Type	Monitoring Frequency	Statistical Base	
51929	Bypass of Trea Facility	tment	Report		occur/mo	Occurrences	Continuous	Monthly Total	Municipal
51929	Bypass of Trea Facility	tment	Report		gal/mo	Estimate	Continuous	Monthly Total	<b>NPDES</b>
Code	Parameter	Qualifie	r Valu	е	Unit	Sample Type	Monitoring Frequency	Statistical Base	Downsite
51925	SSO, Dry Weather	Report			gal/mo	Estimate	Continuous	Monthly Total	<b>Permits</b>
51925	SSO, Dry Weather	Report			occur/12 Mo Cumulative Total	Calculated	Continuous	Total	
51925	SSO, Dry Weather	<=	0		occur/mo	Occurrences	Continuous	Monthly Total	
51927	Release [Sewer], Dry Weather	Report			occur/mo	Occurrences	Continuous	Monthly Total	
51927	Release [Sewer], Dry Weather	Report			gal/mo	Estimate	Continuous	Monthly Total	
			Mon	toring	: Wet Weat	her	•		
Code	Parameter	Qualifie	r Value		Unit	Sample Type	Monitoring Frequency	Statistical Base	
51926	SSO, Wet Weather	Report		ç	gal/mo	Estimate	Continuous	Monthly Total	
51926	SSO, Wet Weather	Report		Cu	ur/12 Mo mulative Total	Calculated	Continuous	Total	
51926	SSO, Wet Weather	<=	0	00	ccur/mo	Occurrences	Continuous	Monthly Total	
51928	Release [Sewer], Wet Weather	Report		g	gal/mo	Estimate	Continuous	Monthly Total	
51928	Release [Sewer], Wet Weather	Report		00	ccur/mo	Occurrences	Continuous	Monthly Total	

## **NPDES Permits**



"Bypass"

The intentional diversion of waste streams from any portion of a treatment facility.

"Discharge" or "Discharge of a Pollutant"

Addition of pollutants

to waters from a source.



#### "Dry Weather Overflow"

A type of sanitary sewer overflow and is defined as one day or any portion of a day in which unpermitted discharge of wastewater from the collection or treatment system other than through the permitted outfall occurs and is not directly related to a rainfall event. Discharges from more than one point within a 24-hour period shall be counted as separate overflows.



#### "Rainfall Event"

Any occurrence of rain, preceded by 10 hours without precipitation that results in an accumulation of 0.01 inches or more. Instances of rainfall occurring within 10 hours of each other will be considered a single rainfall event.

#### "Sanitary Sewer Overflow (SSO)"

An unpermitted discharge of pollutants from the collection or transmission system owned or operated by the permittee other than through a permitted outfall.



#### "Release"

The flow of sewage from any portion of the collection or transmission system owned or operated by the permittee other than through permitted outfalls that does not add pollutants to waters.



#### "Release"

Includes a backup into a building or private property that is caused by blockages, flow conditions, or other malfunctions originating in the collection and transmission system owned or operated by the permittee.

Does not include backups into a building or private property caused by blockages or other malfunctions originating in a private lateral.



#### Bypass, Release and Overflow Reporting

An SSO or Release occurring at one location over a period of up to 24 hours shall be reported as one occurrence.

An SSO or Release occurring at one location over a period of more than 24 hours shall be reported as the appropriate number of occurrences.<sup>1</sup>



#### Bypass, Release and Overflow Reporting

For example, if a SSO discharges continuously from 1 PM to 3 AM the following morning, the event shall be reported as a single violation. Similarly, if the same SSO discharges intermittently for the same time period, it should be reported as one violation. By contrast, if the same SSO did not end until 3 PM two days later, it should be reported as three violations.





If a sanitary sewer overflow discharges continuously from 1 PM to 3 AM the following morning, the event shall be reported as a single violation. Similarly, if the same sanitary sewer overflow discharges intermittently for the same time period, it should be reported as one violation.



If the same sanitary sewer overflow did not end until 3 PM two days later, it should be reported as three violations.



Industrial Contribution
Causing POTW
Upset



EFFLUENT LIMITS
VIOLATIONS



#### **Overflow**

SSO's, including dry-weather overflows, are prohibited.

Releases caused by improper operation or maintenance of the permittee's collection and transmission system are prohibited.



#### **Overflow**

No new or additional flows shall be added upstream of any point in the collection or transmission system that experiences >5 SSO's or Releases (>5 events per year)<sup>2</sup> or would otherwise overload any portion of the system.



#### **Overflow**

<sup>2</sup> When determining if a location experiences chronic SSO's or Releases the term "event(s)" includes dry weather overflows, wet weather overflows, dry weather releases and wet weather releases.



#### **Overflow**

The I/I reduction must be measured by permittee using practices that are in the environmental enging and reported in an attack.

The data period shall be sufficient to easonal rainfall patterns and groundwater table elevations.



#### Section 2.3.3

### **Overflow**

In the event that chronic SSO's or Releases have occurred from a single point in the collection system for reasons that may not warrant the self-imposed moratorium, the permittee may petition TDEC-DWR for a waiver based on mitigating evidence.



#### Section 2.3.3

## Mitigating Circumstances

**Broken Line** 

REPAIR

Blockage

REMOVE

**Power Failure** 

RESTORE

**Pump Failure** 

REPLACE

## Moratorium



# WHAT MAKES A GOOD METRIC?

"It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts..."



**Sherlock Holmes** 

"A Scandal in Bohemia"

## INTEGRATED MPLIANCE FORMATION SYSTEM

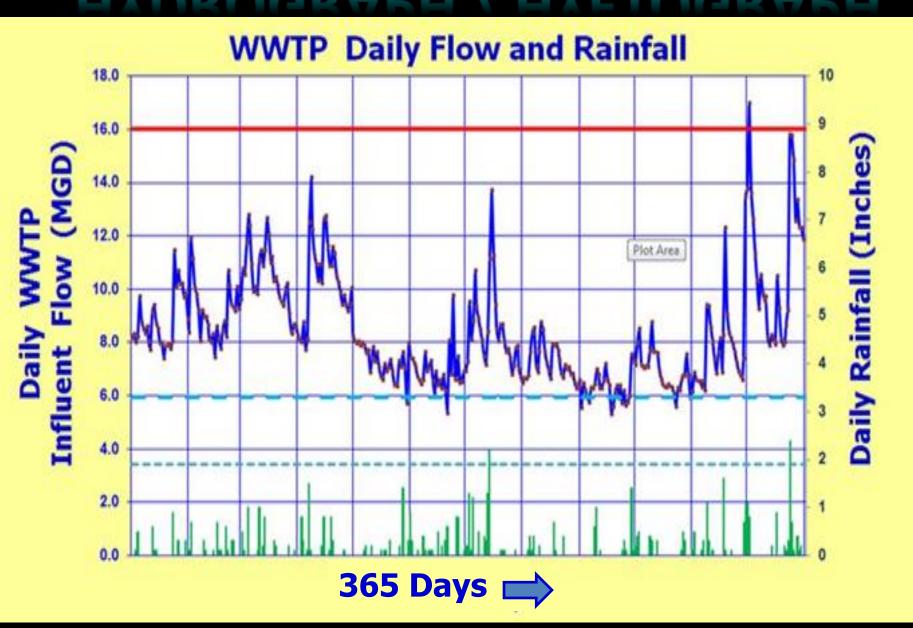
## DMR'S AND MOR'S DATA WWTP OPERATORS COLLECT ON A DAILY BASIS



#### Monthly Operation Reports (MORs)

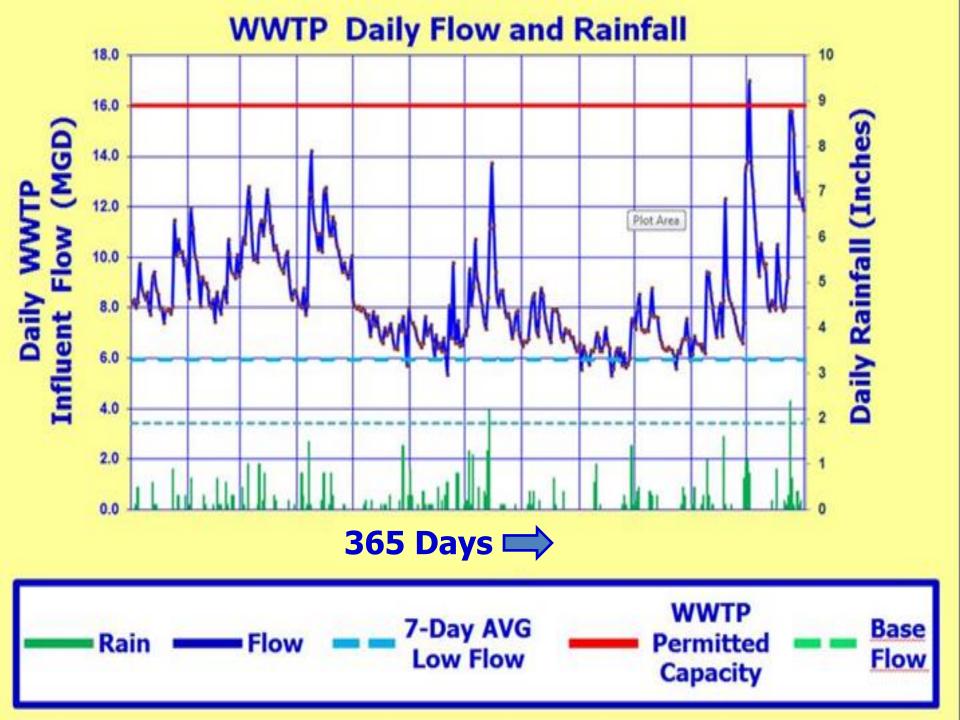
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		ζ		_		×.				Ш		Ш			5 D	ΑY	CI	301	) / E	30[	)	
DATE	RAINFALL (0.1")	INFLUENT FLOW	(MGD)	INFLUENT MAX	FLOW (MGD)	EFFLUENT FLOW	(MGD)	HOURS	BYPASSED	TEMPERATURE	INFLUENT (C)	TEMPERATURE	EFFLUENT (C)	INFLUENT	(mg/L)	EFFLUENT	(mg/L)	EFFLUENT	(POUNDS)	PERCENT	REMOVAL	Į.
1	2	,	3		4		5		6	•	7		8		9	1	0	1	1	1	12	
1																						
2																						
3																						L
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5																						
6																						

### HYDROGRAPH / HYETOGRAPH



## DATA REQUIRED FOR HYDROGRAPH

ELEMENT	DEFINITION	SOURCE	
Daily WWTP Influent Flow	Daily Average Flow	MOR's	
Daily Rainfall	Daily Recorded Rainfall in closest proximity to sewershed.	MOR's	
7-Day AVG Low Flow (7 to 14 Days)	Wastewater flow data at the WWTP during a dry weather period of 7 to 14 days.	MOR's	
Base Flow	The portion of wastewater which includes domestic, commercial, institutional, and industrial sewage and specifically excludes infiltration and inflow.	MOR's & PT	
Permitted WWTP Capacity	WWTP flow via the NPDES Permit	NPDES Permit	
Hydraulic WWTP Capacity	Maximum flow WWTP capable of handling without a ByPass	Permittee	
Time	Calendar Year, Running 365-Day, or November 1st through April 30th	MOR's	



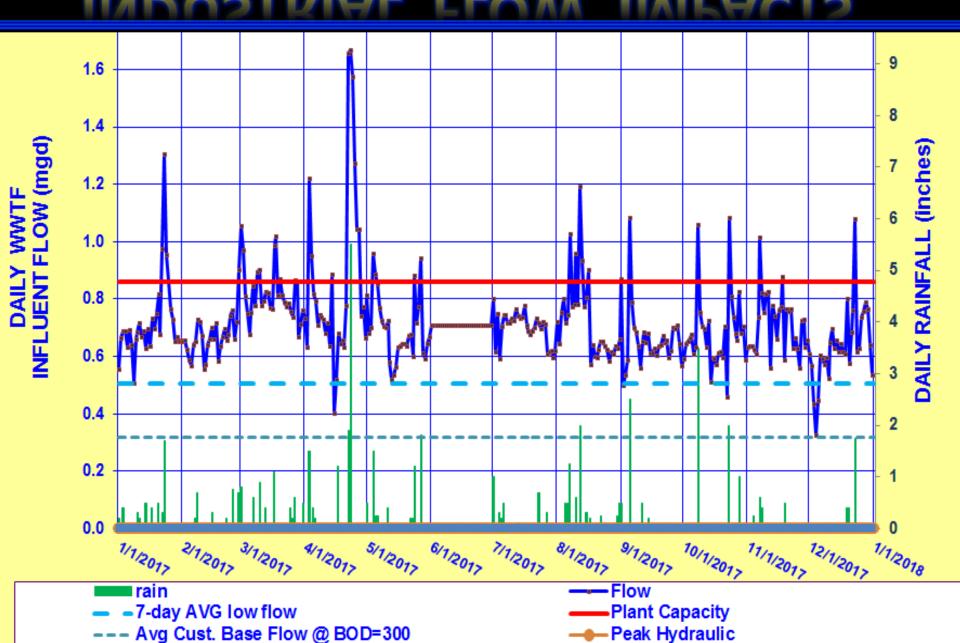


Any flow greater than "Base Sanitary Flow" is caused by I/I

FACTORS IN INDUSTRIAL FLOWS



#### INDUSTRIAL FLOW IMPACTS



## DWR Metrics



#### **DWR** Metrics to get **ON** Moratorium



Chronic (>5) SSO's + Releases at any location.

Volume (Rate x Duration) is NOT part of the metric.



Effluent Violations

QNCR

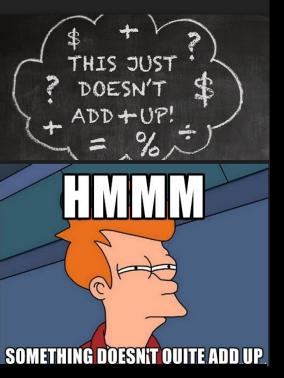


#### **DWR** Metrics to get **OFF** Moratorium



## Reduce or Eliminate "Reported" SSO's + Releases and/or ByPasses

Requirement	Penalty	Amt Due	Due Date
Submit CAP/ER	Contingent	\$20,000.00	20-MAY-11
Initiate CAP/ER within 45d of approval	Contingent	\$10,000.00	15-MAR-11
Complete CAP/ER	Contingent	\$20,000.00	31-DEC-16
Implement SORP within 90 days of written approval	Contingent	\$20,000.00	10-MAY-11
Submit CMOM Program	Contingent	\$20,000.00	12-AUG-11
Submit 1st Annual CMOMs Report	Contingent	\$5,000.00	01-AUG-12
Submit 2nd Annual CMOMs Report	Contingent	\$5,000.00	01-AUG-13
Maintain capacity, collection, and treatment protocols	Contingent	\$20,000.00	14-FEB-12
Complete all requirements of the Order	Contingent	\$20,000.00	31-JUL-17
Submit List of Legally Obligated Sewer Taps	Contingent	\$20,000.00	15-MAR-11
Submit Current List of Legally Obligated Sewer Taps	Contingent	\$20,000.00	15-MAR-11
Moratorium on new connections	Contingent	\$20,000.00	31-JUL-17
Upfront Civil Penalty	Upfront	\$0.00	15-MAR-11
		\$200,000.00	



IF THE WORDS DON'T ADD UP, ITS USUALLY BECAUSE THE TRUTH WASN'T INCLUDED IN THE EQUATION.

%I/I

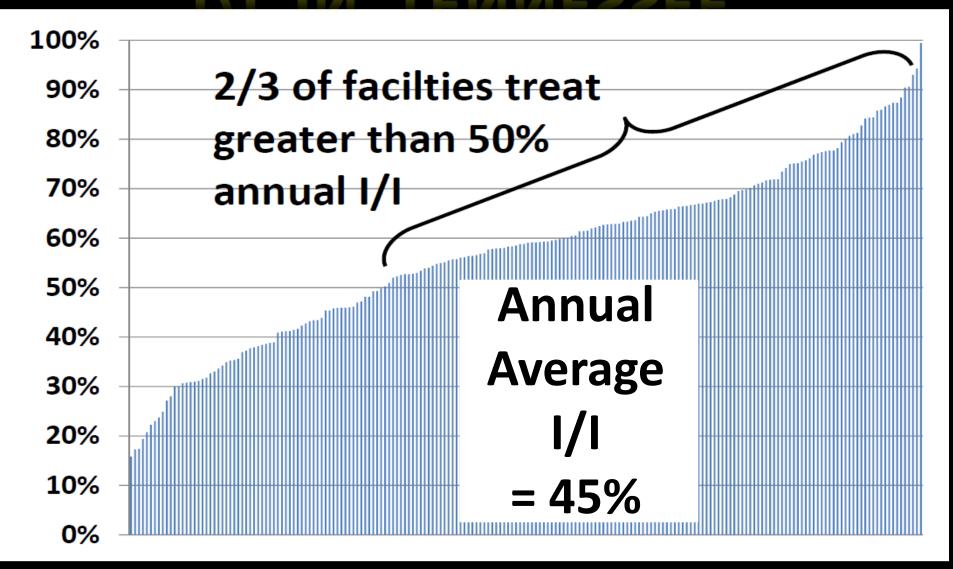
VS.

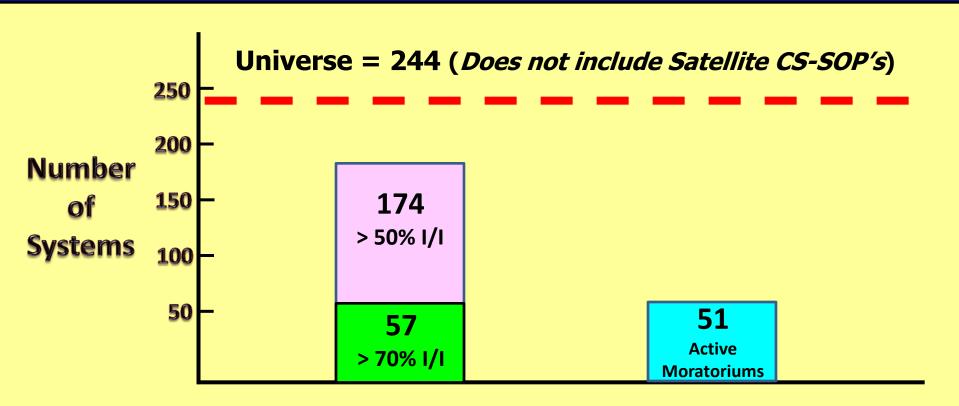
**Moratoriums** 

VS.

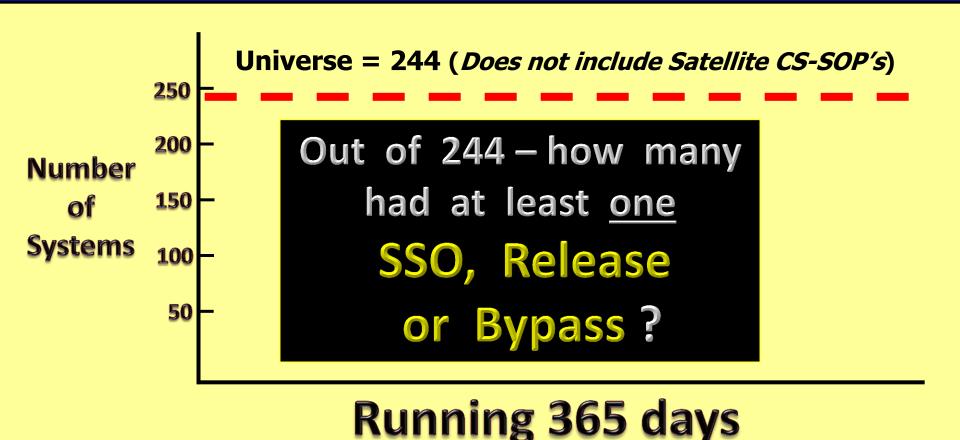
SSO's

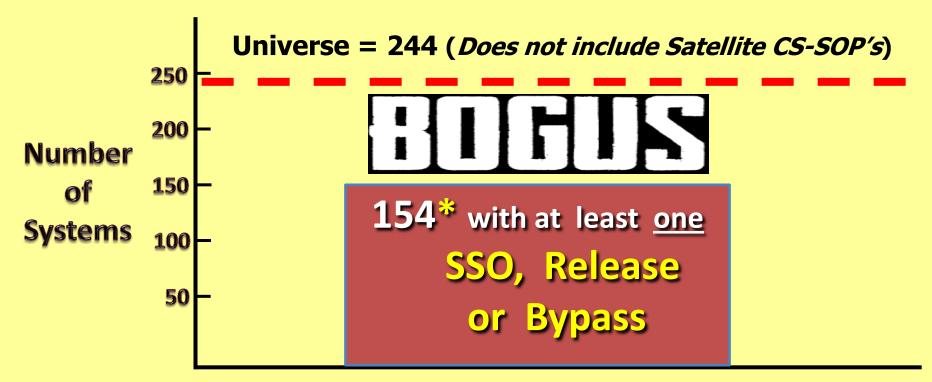
## I/I IN TENNESSEE





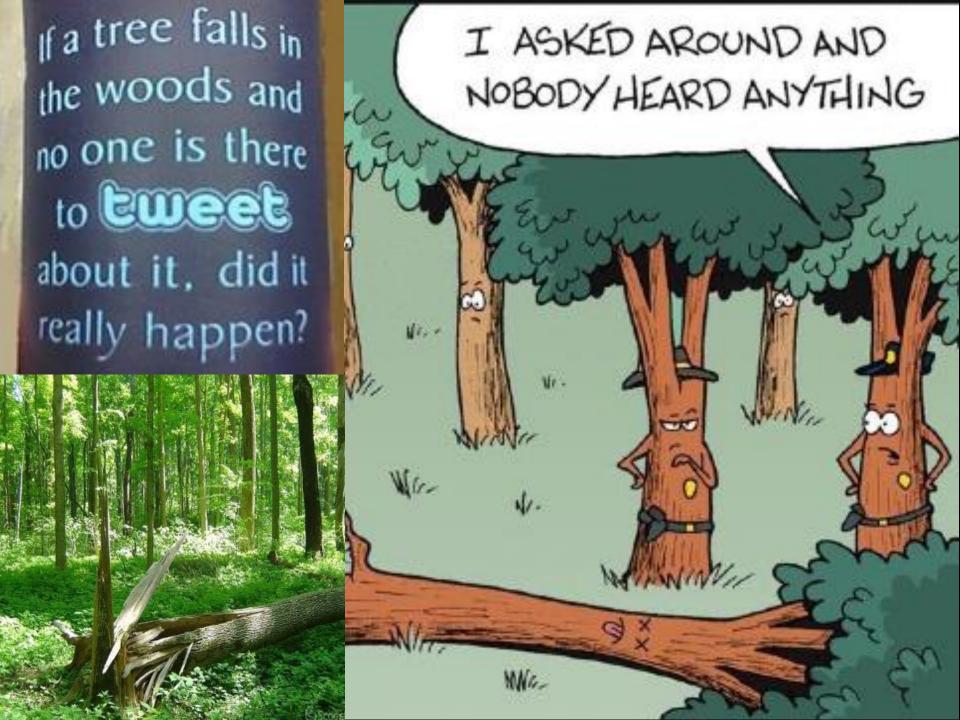
2017



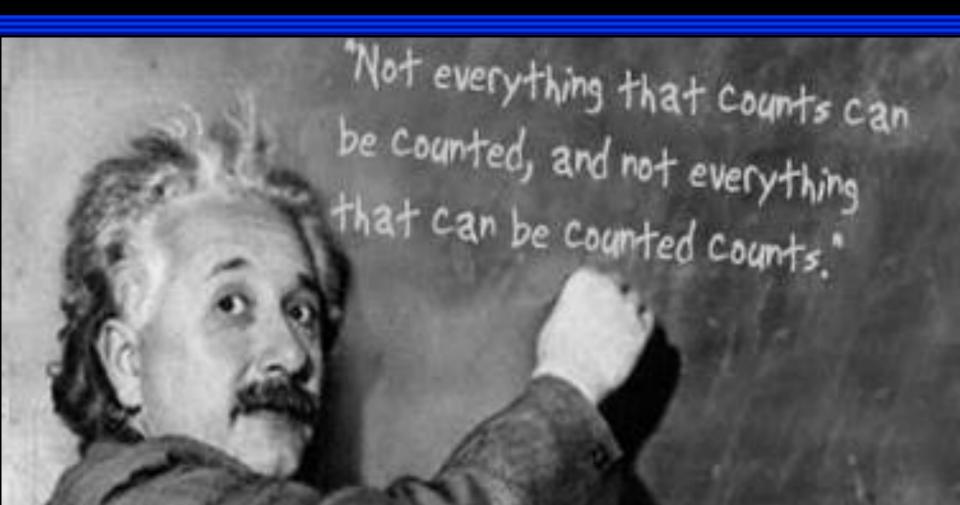


Running 365 days

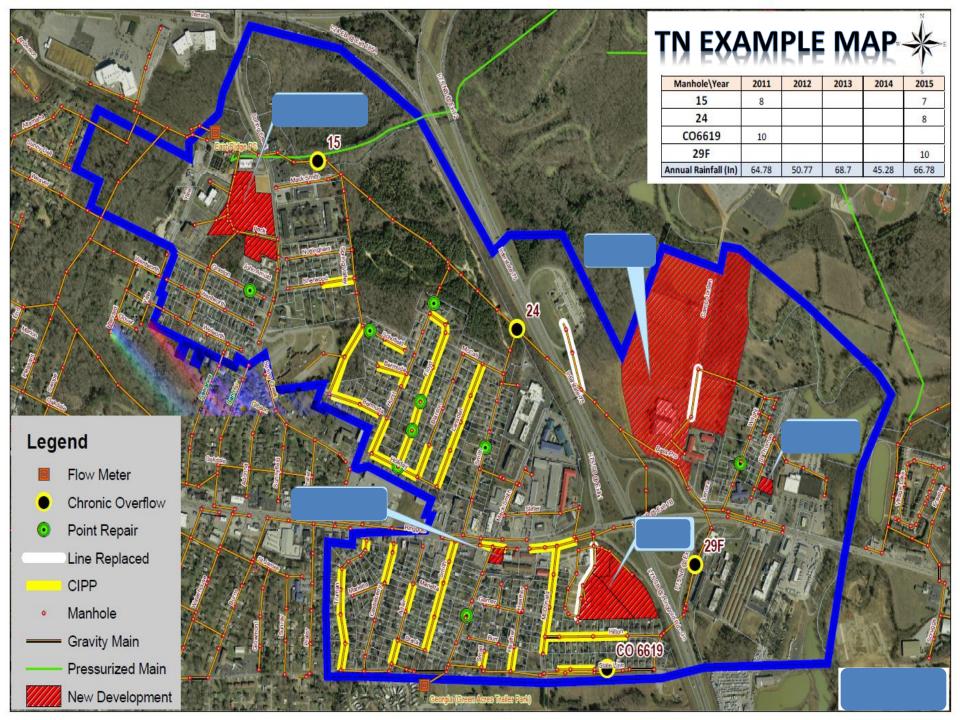
\* Total = 3,124; AVG = 23; Median = 5



## Did Albert Einstein ever say anything that was relevant to sewer collection system metrics?



Permit No	Permittee Name	Parameter	Condition	Season	Sum Total
		Bypass	Wet Weather	All Year	331
		Overflow	Wet Weather	All Year	225
		Overflow	Dry Weather	All Year	139
		Overflow	Dry Weather	All Year	132
		Overflow	Dry Weather	All Year	121
		Overflow	Wet Weather	All Year	112
		Overflow	Wet Weather	All Year	74
		Overflow	Dry Weather	All Year	58
		Overflow	Wet Weather	All Year	56



SSOs at MH #15 (Basin 10)													
	J	F	M	A	M	J	J	A	S	0	N	D	Total
2009			1						1			2	4
2010	1	1									1		3
2011	1		1	3					1		1	1	8
2012	2								1	1		•	4
2013	1			1			1				1	1	5
2014				1					1	1		1	4
2015	1			2				1			1	2	7
2016		2											2

	SSOs at MH # 29F (Basin 10)												
	J	F	M	A	M	J	J	A	S	0	N	D	Total
2009													
2010													
2011													
2012	2									1			3
2013					1		1					1	3
2014		1		1						1		1	4
2015	1	1	1	2				1		1	1	2	10
2016		2											2

	SSOs at MH # 24 (Basin 10)												
	J	F	M	A	M	J	J	A	S	O	N	D	Total
2009													
2010													
2011													
2012	2												2
2013					1		1				1	1	4
2014		1		1						1		1	4
2015				2				1		1	1	2	7
2016		2											

#### ESTIMATED INFLOW AND INFILTRATION RATE REDUCTION DUE TO SEWER SYSTEM REHABILITATION

Source Defect	Range	Value Used
Manhole Cover with Six Vent Holes @ 1-Inch Submergence		32.2 GPM <sup>(1)</sup>
Manhole Cover with Six Vent Holes @ 1/2-inch Submergence		16.3 GPM <sup>(1)</sup>
Manhole Cover with One Pickhole @ 1/2-inch Submergence		17.2 GPM <sup>(1)</sup>
Manhole Cover with One Plugged Pickhole @ 1/2-inch Submergence		12.8 GPM <sup>(1)</sup>
Manhole Frame to Cone Seal	0.5 to 5.0 GPM (2)	2.75 GPM
Brick or Block Manhole Wall	0.1 to 5.0 GPM (2)	2.55 GPM
Manhole Invert and Pipe Connection	0.1 to 5.0 GPM (2)	2.55 GPM
Infiltration Rate in Clay Sewer Pipelines without PVC Joint @ 9-Inches Submergence	1,660 to 71,050 GPD/Inch/Mile (3)	29,000 GPD/Inch/Mile
Infiltration Rate in Concrete Sewer Pipelines without Rubber Gasket Joint @ 9-Inches Submergence	235 to 52,800 GPD/Inch/Mile (3)	14,000 GPD/Inch/Mile

#### References

- (2) Existing Sewer Evaluation & Rehabilitation, WEF Manual of Practice FD-6, ASCE Manual and Report on Engineering Practice No. 62
- (3) Metcalf & Eddy, Inc. Wastewater Engineering: Collection, Treatment, Disposal, 1972.

## ESTIMATES VS. ACTUALS

### POWERPOINT PRESENTATION

**XYZ** Utilities

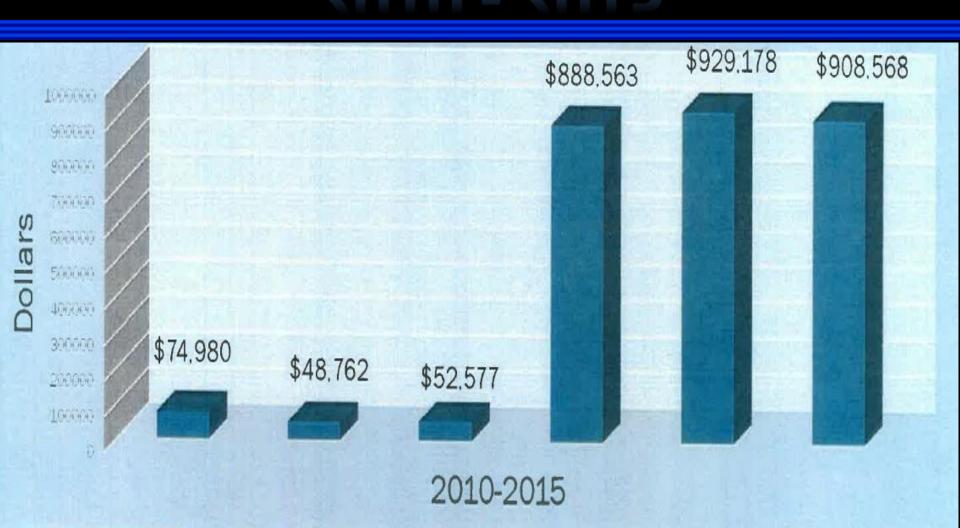
SSO Forgiveness Rationale

In Order to Avoid

A Self-Imposed Moratorium

FEBRUARY 2016

## CAPITAL LAYOUT 2010 - 2015



### PROGRESS OF ADMINISTRATIVE ORDER ON SSO

Effects of Spent Capital on SSO's



## REFERENCES

Simple Method for Estimating I/I Using Treatment Plant Flow Monitoring Reports

A Self Help Tool for Operators
by
George E. Kurz, P.E., DEE
Greg Ballard, P.E.

**Brett Ward** 

Method to Verify I/I Reduction to Obtain Moratorium Relief by George E. Kurz, P.E., DEE Kevin Colvett, P.E.

## REGRESSION ANALYSIS



Effects of RD-I/I (rainfall derived I/I) and long-term dry weather infiltration.

RD-I/I is estimated by linear regression of I/I quantity compared to rainfall depth for discrete events.

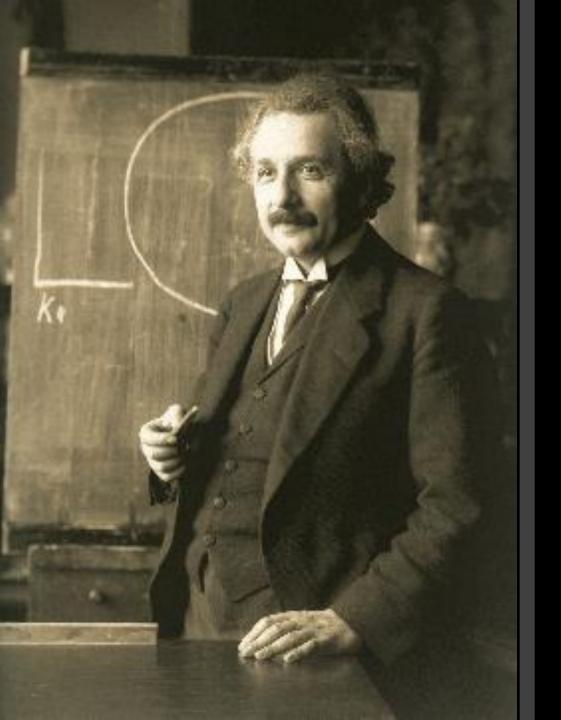
## REGRESSION ANALYSIS



TDEC-DWR is using a regression analysis "Model" for analyzing the statistical relationship between the 2<sup>nd</sup> day RD-I/I and two-day rainfall event.

Reference: George E. Kurz, P.E., DEE et al

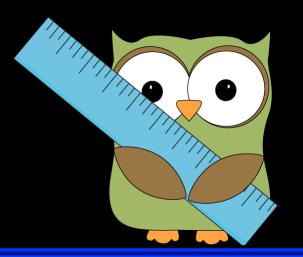




All models
are wrong,
but some
are useful.

- Albert Einstein

# MORATORIUM METRICS



## Kurzian Regression Model

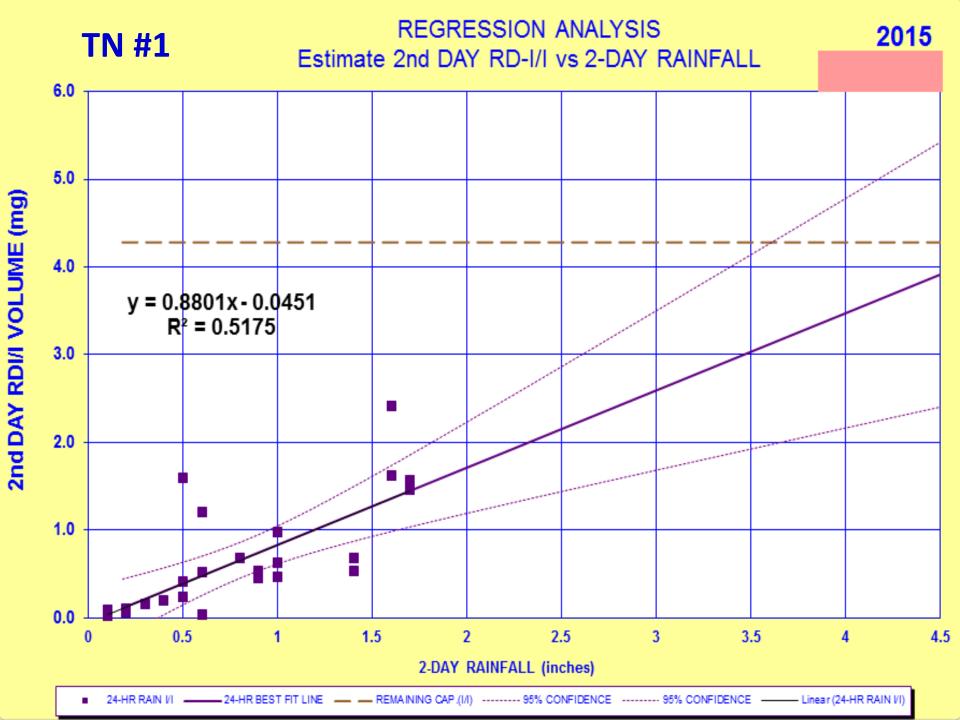


Using MOR Data.

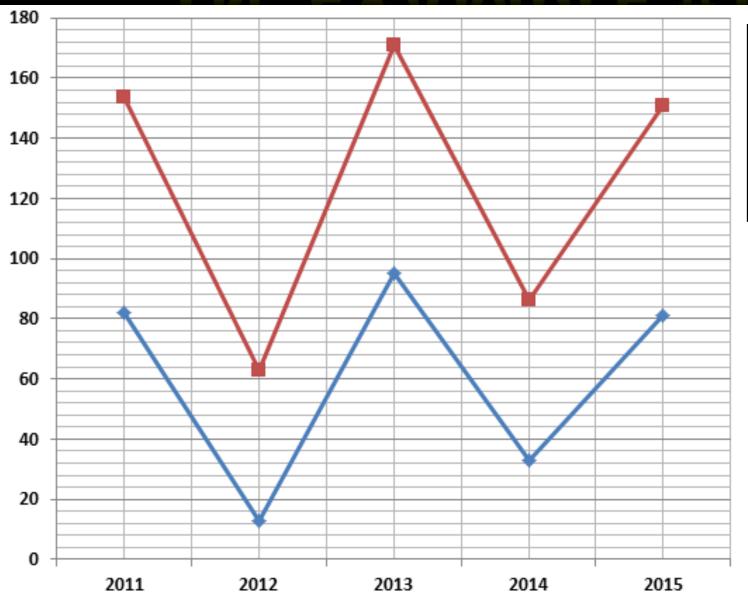
# TN EXAMPLE #1 (CMOM Annual Report)

It should also be noted that dry weather overflows have been significantly reduced with the continuation of our cleaning, CCTV and FOG programs.

Year	Wet Weather Overflow	Dry Weather Overflow	Annual Rainfall (in)	Departure from Normal Rainfall
2011	82	27	71.61	+15.91
2012	13	32	49.85	-5.9
2013	95	25	76.17	+20.47
2014	33	26	53.04	-2.66
2015	81	11	69.96	+14.26



# TN EXAMPLE #1



Year	WW SSO's	Annual Rainfall (in)
2011	82	71.61
2012	13	49.85
2013	95	76.17
2014	33	53.04
2015	81	69.96

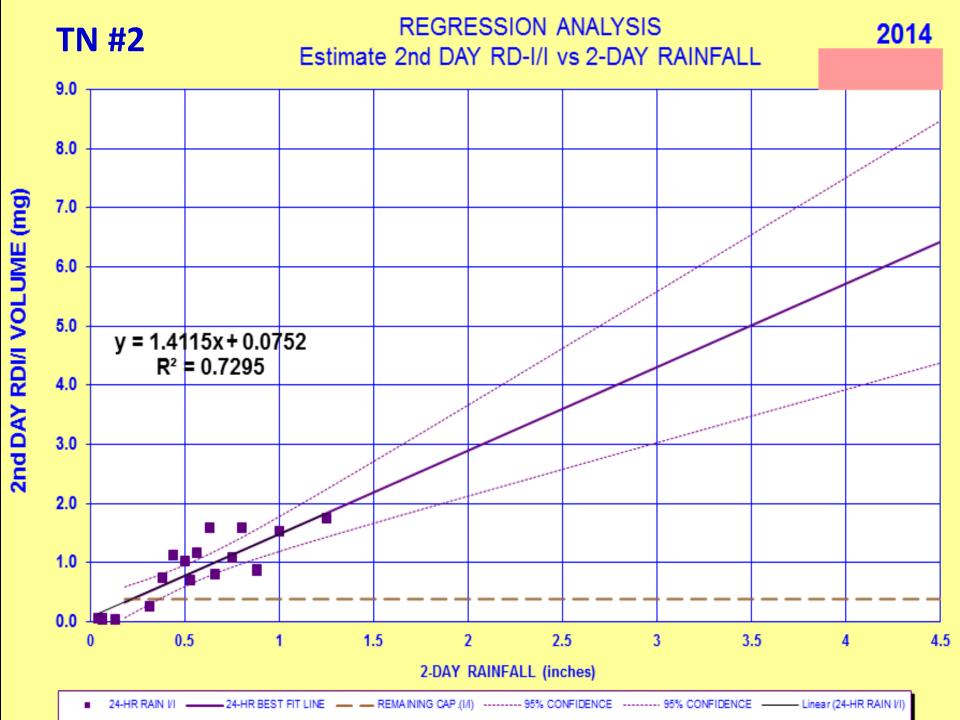


→ WW SSO's

# TN EXAMPLE #2

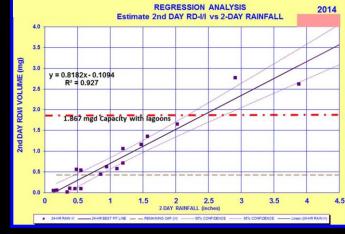
MONITORING PERIOD	2011	2012	2013	2014	2015	2016
Start Date	1/1/11	1/1/12	1/1/13	1/1/14	1/1/15	1/1/16
End Date	12/31/11	12/31/12	12/31/13	12/31/14	12/31/15	12/31/16
Total Rain (in)	53.87	44.91	55.91	64.33	51.94	45.89
I/I as % of annual flow by BOD dilution (if BOD=300)	85%	78%	81%	84%	82%	80%
ADDWF & RDI/I						
7-day ADDWF (mgd)	0.340	0.325	0.315	0.283	0.258	0.246
2nd Day RDI/I for 2-day rainfall for 5-year rainfall (mg)	3.4	3.7	3.7	3.6	3.4	3.4
Annual I/I calculated by base week (MG)	225	150	221	204	158	122
Annual I/I calculated by BOD-CBOD dilution (MG) (BOD: 300 mg/l)	298	209	271	259	205	170

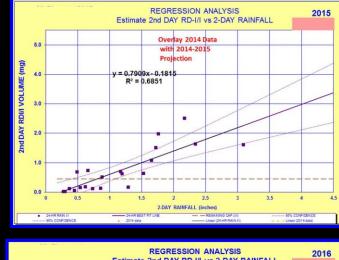
YEAR	2011	2012	2013	2014	2015	2016
Total Rain (in)	53.87	44.91	55.91	64.33	51.94	45.89
% I/I	85	78	81	84	82	80
Annual I/I (MG)	225	150	221	204	158	122

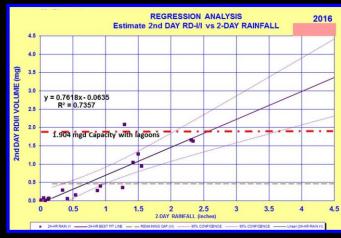


# TN EXAMPLE #2

MONITORING PERIOD	2014	2015	2016
Start Date	1/1/14	1/1/15	1/1/16
End Date	12/31/14	12/31/15	12/31/16
Total Rain (in)	64.33	51.94	45.89
I/I as % of annual flow by BOD dilution (if BOD=300)	84%	82%	80%
ADDWF & RDI/I			
7-day ADDWF (mgd)	0.283	0.258	0.246
2nd Day RDI/I for 2-day rainfall for 5-year rainfall (mg)	3.6	3.4	3.4
Annual I/I calculated by base week (MG)	204	158	122
Annual I/I calculated by BOD-CBOD dilution (MG) (BOD: 300 mg/l)	259	205	170







#### WWTF INFLUENT MONITORING DATA ANALYSES

for

## TN EXAMPLE #3

#### **ANALYSIS PERIOD**

JANUARY 01, 2015, to DECEMBER 31, 2015

I/I as a Percent of Annual Flow:

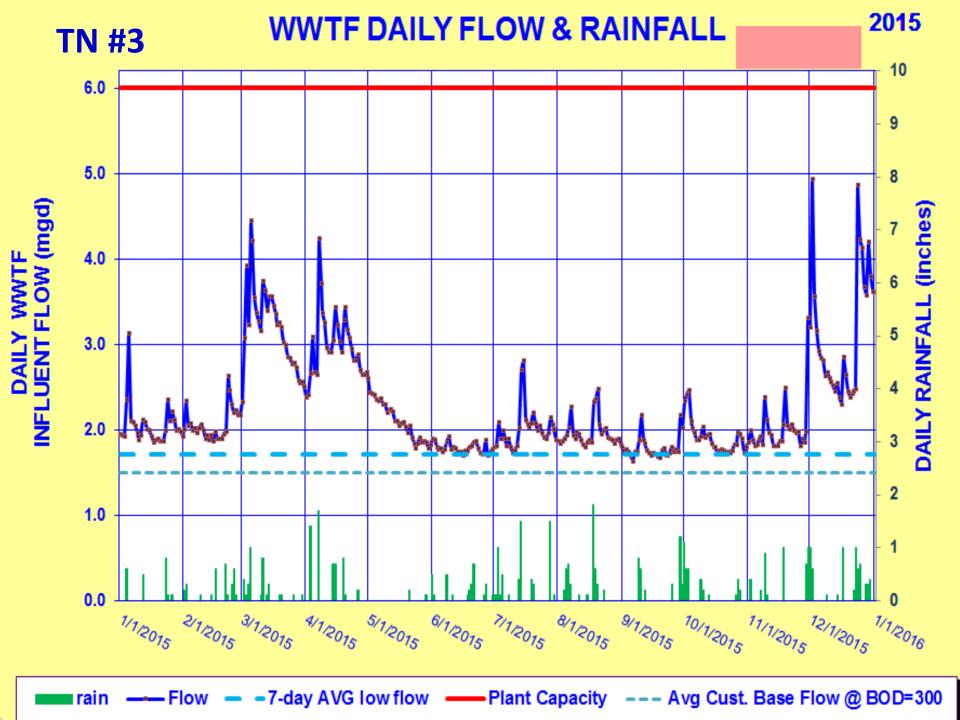
34%

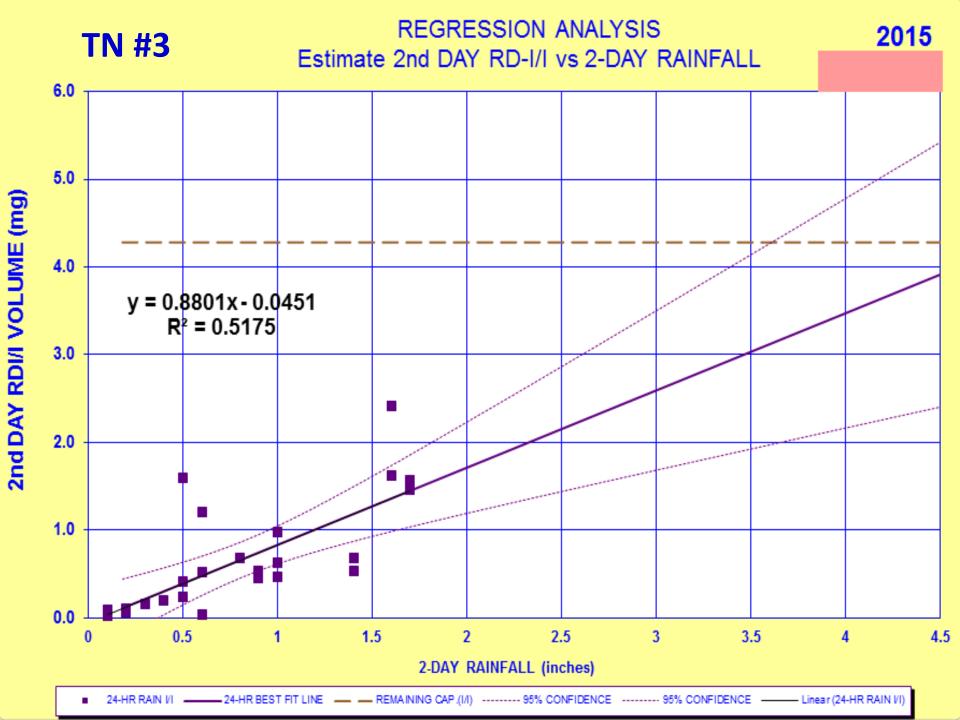
Calculated by BOD dilution

Estimated Annual I/I Cost: \$510,000

Years to Payback: 10.5 (After 50% Reduction)

Copyright 2015 by: George E. Kurz, P.E., DEE
1104 Berwick Trail
Madison, TN 37115-4909
george.kurz@comcast.net
615-714-6120





#### WWTF INFLUENT MONITORING DATA ANALYSES

for

# TN EXAMPLE #4

#### ANALYSIS PERIOD

JANUARY 01, 2012, to DECEMBER 31, 2012

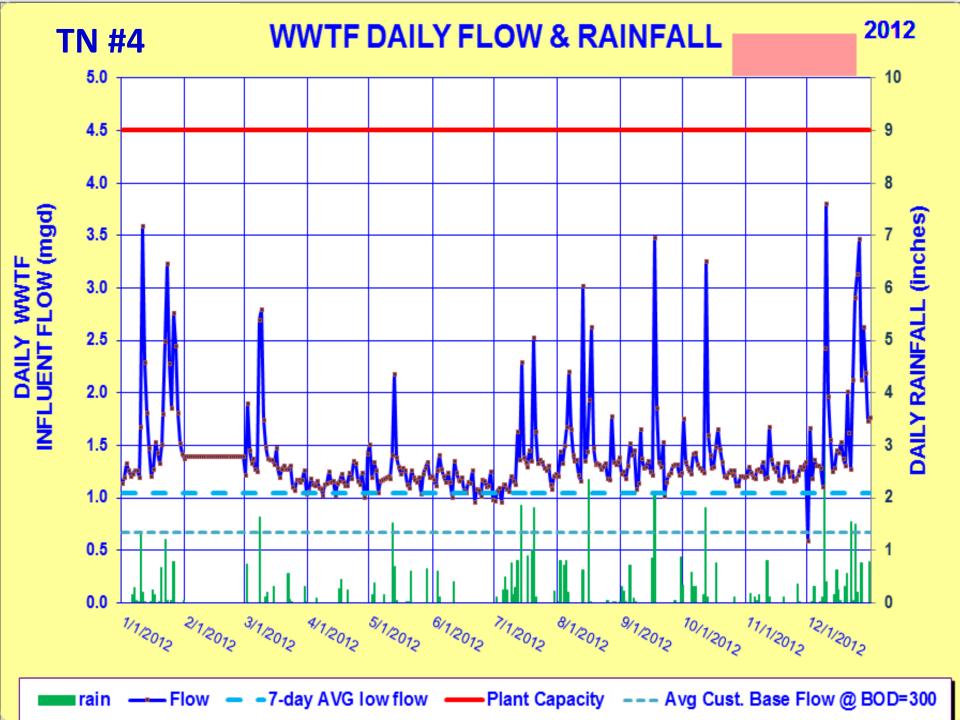
I/I as a Percent of Annual Flow:

53%

Calculated by BOD dilution

Years to Payback: 10.5
(After 50% Reduction)

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#### WWTF INFLUENT MONITORING DATA ANALYSES

for

# TN EXAMPLE #5

#### FLOW METER LIKELY PEGGED AT 2.5 MGD

#### **ANALYSIS PERIOD**

JANUARY 01, 2014, to DECEMBER 31, 2014

I/I as a Percent of Annual Flow:

**52%** 

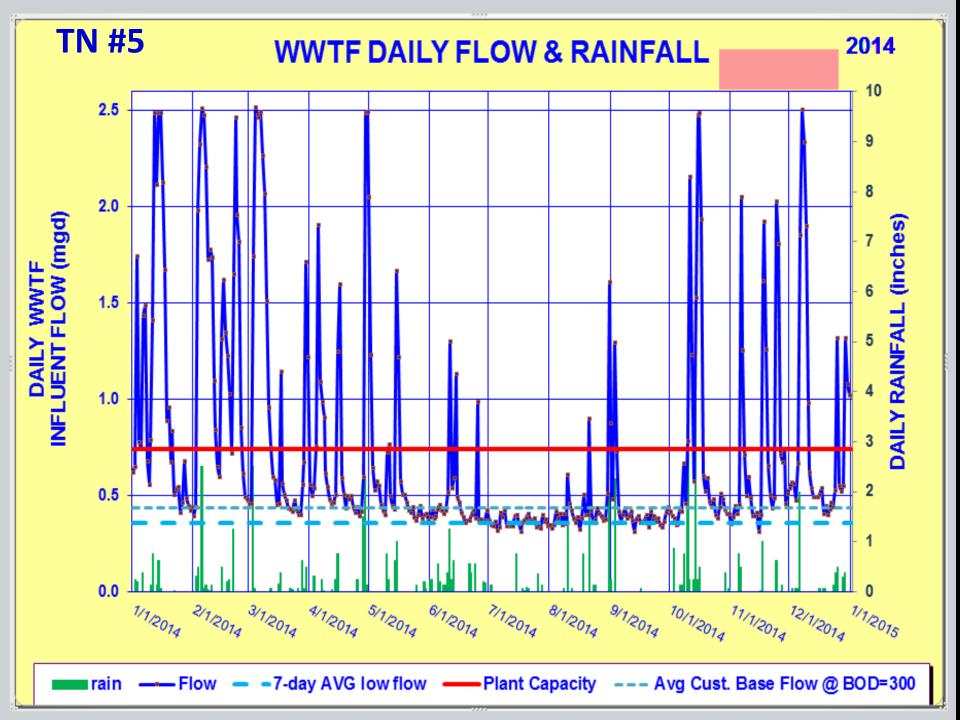
Calculated using ADDWF - 7-day low flow

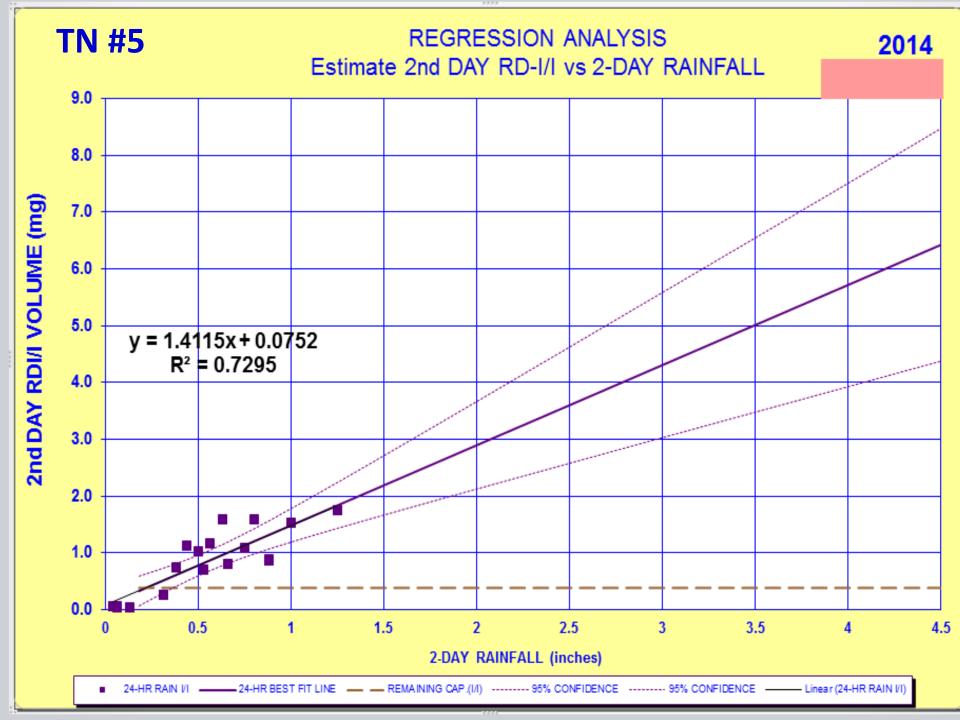
Estimated Annual I/I Cost: \$260,000

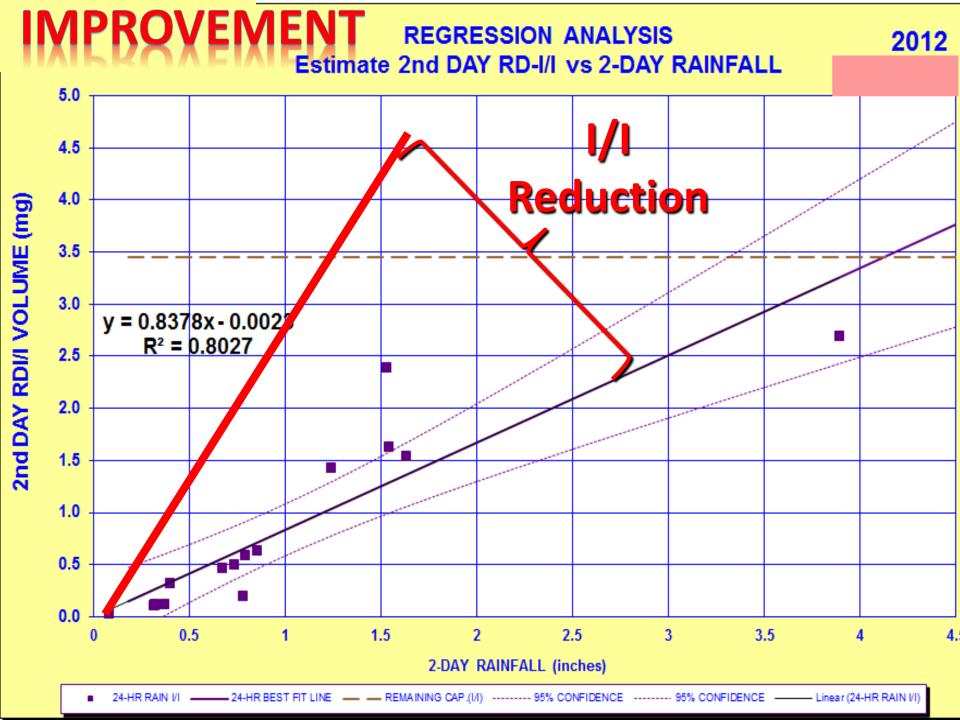
Years to Payback: 10.5

(After 50% Reduction)

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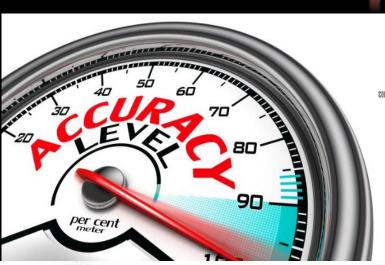


# COLLECTION SYSTEM METRICS



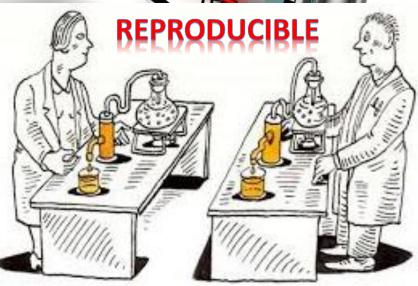


# MORATORIUM METRICS GOALS





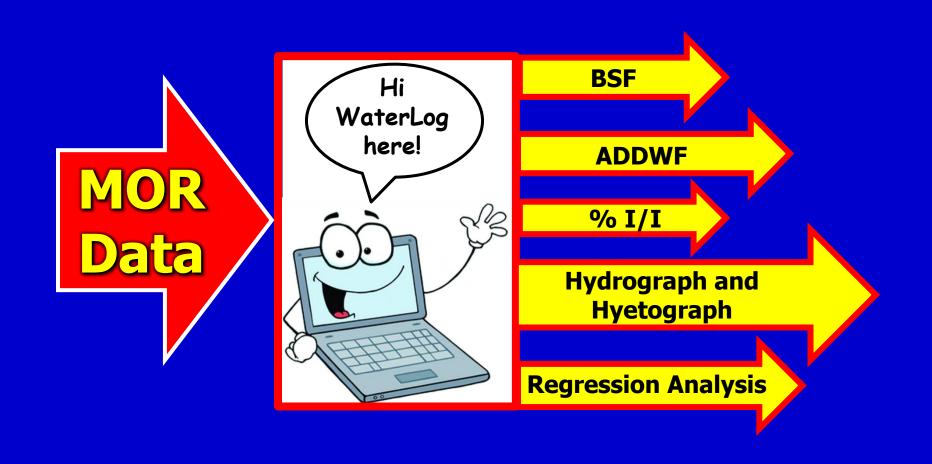




Easy to understand



### Inputs and Outputs



**Better Data = Better Analysis** 



# Take Home Points

#### KEY FACTORS FOR MORATORIUM RELIEF

The capacity of the sewer system between the proposed connection and the chronic overflow/release points.

Compliance record for the WWTP—no effluent violations related to I/I.

Using the last 12 months of MOR data does the regression line model shows significant improvement.







# If you don't Reduce I/I

A lot of Money is going to be flushed down the toilet.





#### Tennessee

120 Billion gallons per year

331 Million gallons per day

181 out of 242 (or 82%)
of municipal WWTPs
exceed their rated design
capacity for a
2-year, 24-hour storm
(3.4 inches)



#### Tennessee

Treatment O&M Cost

@ \$1.80/1,000 gallons = \$200,000,000/year\*

\* Does not include water that does not get to the WWTP or exceeds the influent flow metering capacity of the WWTP.



Tennessee

Treatment O&M Cost

(a) \$1.80/1,000 gallons = \$200,000,000/year\*

\* Does not include extra debt service and depreciation on capacity already installed.



Tennessee

When ALL costs are considered the Total Annual Cost could be:

\$1 BILLION

#### I/I IMPLICATIONS

The \$\$\$\$ to pump and treat clean I/I water means higher O&M cost and thus Higher Sewer Rates.

It means the Loss of WWTP Capacity available to customers or development.

It means a WWTP upgrade LARGER and SOONER than necessary.

### TDEC-DWR EXPECTATIONS

Every WWTP project has to have Reasonable Alternatives evaluated using Life Cycle Cost Analysis (LCCA).

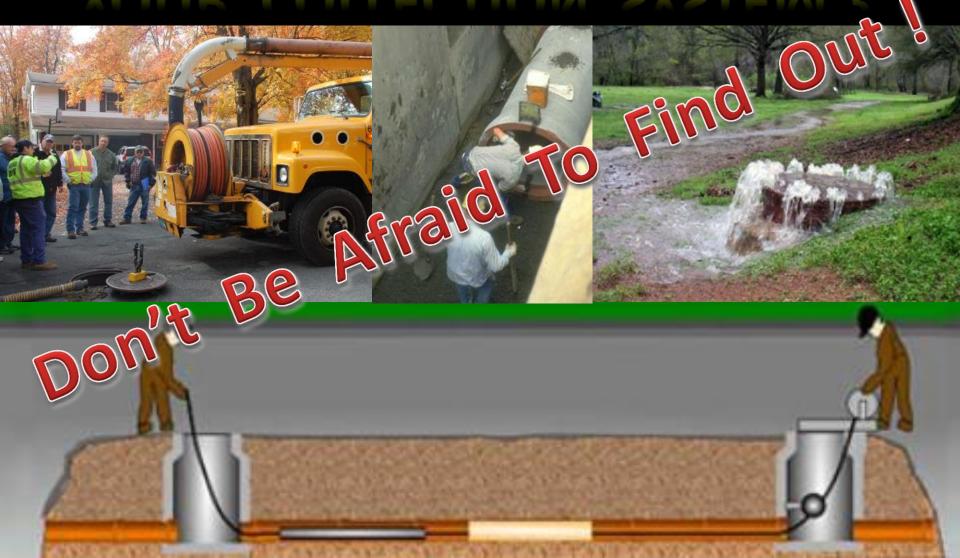
The impact of capacity increases versus solving I/I must be considered in the LCCA.

TCEC-DWR is authorized to judge engineering documents on the basis of generally accepted standards.

## AFRAID OF A DOCTOR'S EXAM?



# WHAT IS THE HEALTH OF YOUR COLLECTION SYSTEM?















United's leadership explores the use of Satellites and Drones to identify leaks and overflows from the sky, and ...



# Is this the future for collection system inspections?





# ThankYou



# 



# Bob O'Dette

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